



- ☐ Tentative Specification  
☒ Preliminary Specification  
☐ Approval Specification

**MODEL NO.: V460HK1**  
**SUFFIX: PS1**

**Customer:**

**APPROVED BY**

**SIGNATURE**

\_\_\_\_\_  
Name / Title

**Note**

\_\_\_\_\_  
Please return 1 copy for your confirmation with your signature and comments.

| Approved By     | Checked By | Prepared By |
|-----------------|------------|-------------|
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**REVISION HISTORY**

| Version  | Date          | Page(New) | Section | Description                                     |
|----------|---------------|-----------|---------|---|
| Ver. 1.0 | Apr. 26, 2011 | All       | All     | The preliminary specification was first issued. |

**1. GENERAL DESCRIPTION****1.1 OVERVIEW**

V460HK1-PS1 is a 46" TFT Liquid Crystal Display product with driver ICs and 4ch-LVDS interface. This product supports 1920 x 1080 Full HDTV format and can display 1.07G (8-bit+Hi-FRC)colors. The backlight unit is not built in.

**1.2 FEATURES**

| CHARACTERISTICS ITEMS             | SPECIFICATIONS  |
|-----------------------------------|---|
| Screen Diagonal [in]              | 46  |
| Pixels [lines]                    | 1920 x 1080   |
| Active Area [mm]                  | 1018.08(H) x 572.67(V) (46" diagonal)   |
| Sub-Pixel Pitch [mm]              | 0.17675(H) x 0.53025(V)   |
| Pixel Arrangement                 | RGB vertical stripe   |
| Weight [g]                        | TYP. 2500g  |
| Physical Size [mm]                | 1049.48(H) x 627.37(V) x 1.78(D) Typ.   |
| Display Mode                      | Transmissive mode / Normally black  |
| Contrast Ratio                    | 6500:1 Typ.<br>(Typical value measure at CMI's module)  |
| Glass thickness (Array / CF) [mm] | 0.7 / 0.7   |
| Viewing Angle (CR>20)             | +88/-88(H), +88/-88(V) Typ. (CR ≥ 20)<br>(Typical value measure at CMI's module)  |
| Color Chromaticity                | Rc = (0.650, 0.325)<br>Gc = (0.265, 0.570)<br>Bc = (0.131, 0.122)<br>Wc= (0.297, 0.344)<br>* Please refer to "color chromaticity" on p.24 |
| Cell Transparency [%]             | 4.8%  |
| Polarizer Surface Treatment       | Super Wide View Glare coating, Hard coating (3H)  |

**1.3 MECHANICAL SPECIFICATIONS**

| Item                            | Min.  | Typ. | Max. | Unit        | Note   |
|---------------------------------|---|------|------|-------------|--------|
| Weight                          | ---   | 2500 | ---  | g           | -      |
| I/F connector mounting position | The mounting inclination of the connector makes the screen center within ± 0.5mm as the horizontal. |      |      | 51.75/22.25 | (1)(2) |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

Note (2) Connector mounting position

**2. ABSOLUTE MAXIMUM RATINGS****2.1 ABSOLUTE RATINGS OF ENVIRONMENT**

| Item                          | Symbol | Value |      | Unit | Note     |
|-------------------------------|--------|-------|------|------|----------|
|                               |        | Min.  | Max. |      |          |
| Storage Temperature           | TST    | -20   | +60  | °C   | (1)      |
| Operating Ambient Temperature | TOP    | 0     | 50   | °C   | (1), (2) |

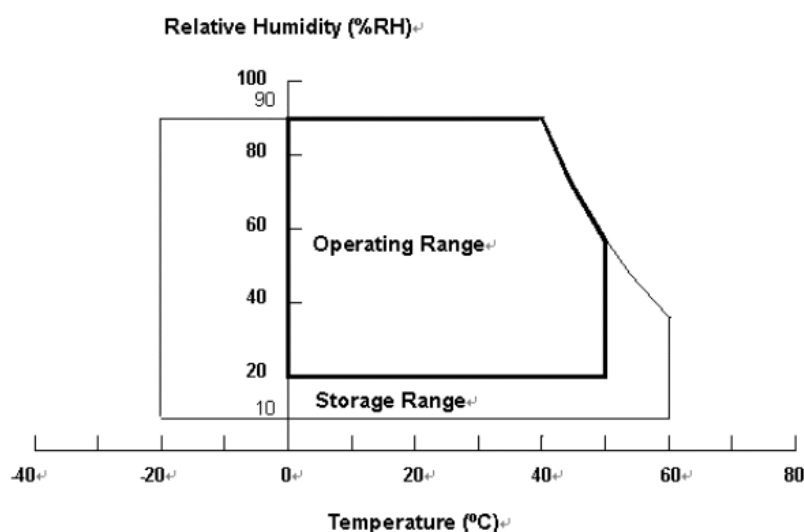
Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. ( $T_a \leq 40$  °C).

(b) Wet-bulb temperature should be 39 °C Max. ( $T_a > 40$  °C).

(c) No condensation.

Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65 °C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65 °C. The range of operating temperature may degrade in case of improper thermal management in final product design.



**2.2 PACKAGE STORAGE**

When storing modules as spares for a long time, the following precaution is necessary.

- (a) Do not leave the module in high temperature, and high humidity for a long time, It is highly recommended to store the module with temperature from 0 to 35 °C at normal humidity without condensation.
- (b) The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

**2.3 ELECTRICAL ABSOLUTE RATINGS**

| Item                 | Symbol | Value |      | Unit | Note |
|----------------------|--------|-------|------|------|------|
|                      |        | Min.  | Max. |      |      |
| Power Supply Voltage | VCC    | -0.3  | 13.5 | V    | (1)  |
| Logic Input Voltage  | VIN    | -0.3  | 3.6  | V    |      |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

## 3. ELECTRICAL CHARACTERISTICS

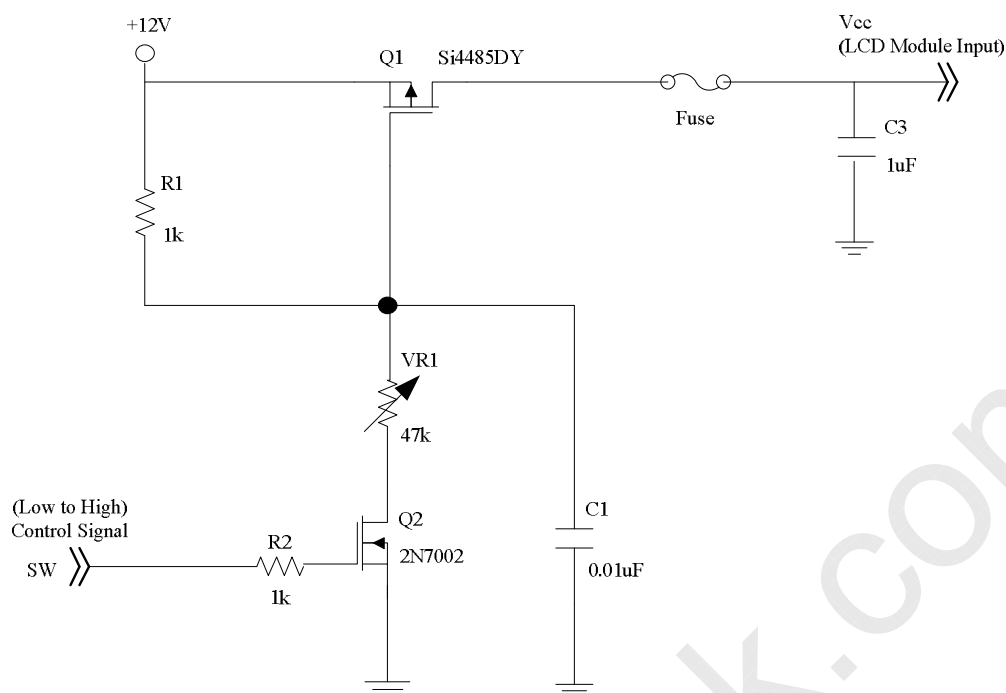
### 3.1 TFT LCD MODULE

(Ta = 25 ± 2 °C)

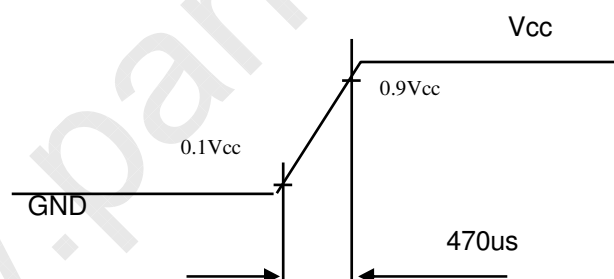
| Parameter            |   | Symbol            | Value |      |      | Unit | Note |
|----------------------|---|-------------------|-------|------|------|------|------|
|                      |   |                   | Min.  | Typ. | Max. |      |      |
| Power Supply Voltage |   | V <sub>CC</sub>   | 10.8  | 12   | 13.2 | V    | (1)  |
| Rush Current         |   | I <sub>RUSH</sub> | —     | —    | 4.55 | A    | (2)  |
| Power Supply Current | White Pattern                             | —                 | —     | 0.58 | —    | A    | (3)  |
|                      | Horizontal Stripe                         | —                 | —     | 1.3  | 1.37 | A    |      |
|                      | Black Pattern                             | —                 | —     | 0.58 | —    | A    |      |
| LVDS interface       | Differential Input High Threshold Voltage | V <sub>LVTH</sub> | +100  | —    | —    | mV   | (4)  |
|                      | Differential Input Low Threshold Voltage  | V <sub>LVTL</sub> | —     | —    | -100 | mV   |      |
|                      | Common Input Voltage                      | V <sub>CM</sub>   | 1.0   | 1.2  | 1.4  | V    |      |
|                      | Differential input voltage                | V <sub>ID</sub>   | 200   | —    | 600  | mV   |      |
|                      | Terminating Resistor                      | R <sub>T</sub>    | —     | 100  | —    | ohm  |      |
| CMOS interface       | Input High Threshold Voltage              | V <sub>IH</sub>   | 2.7   | —    | 3.3  | V    |      |
|                      | Input Low Threshold Voltage               | V <sub>IL</sub>   | 0     | —    | 0.7  | V    |      |

Note (1) The module should be always operated within the above ranges.

Note (2) Measurement condition:

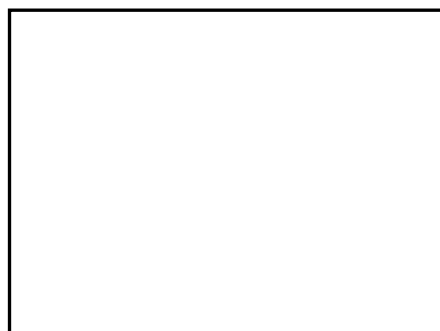


**Vcc rising time is 470us**



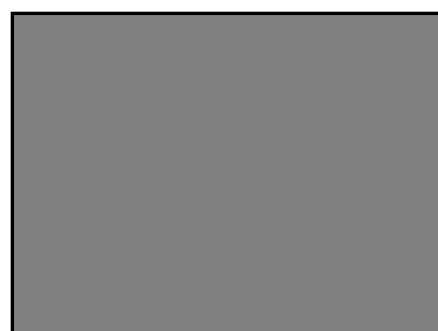
Note (3) The specified power supply current is under the conditions at  $V_{CC} = 12\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ ,  $f_v = 120\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. White Pattern

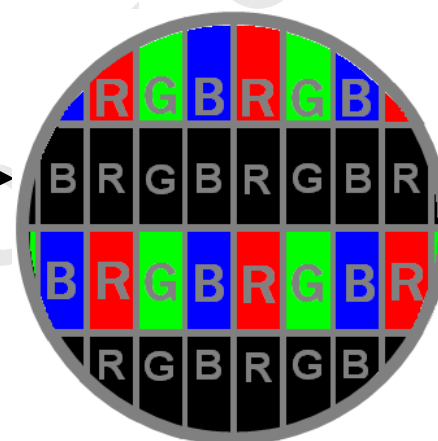
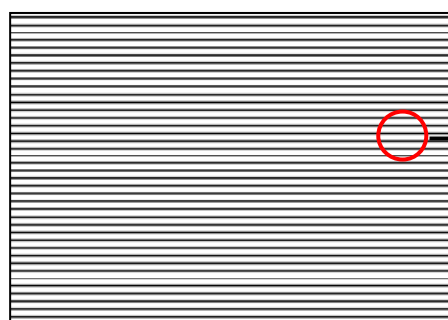


Active Area

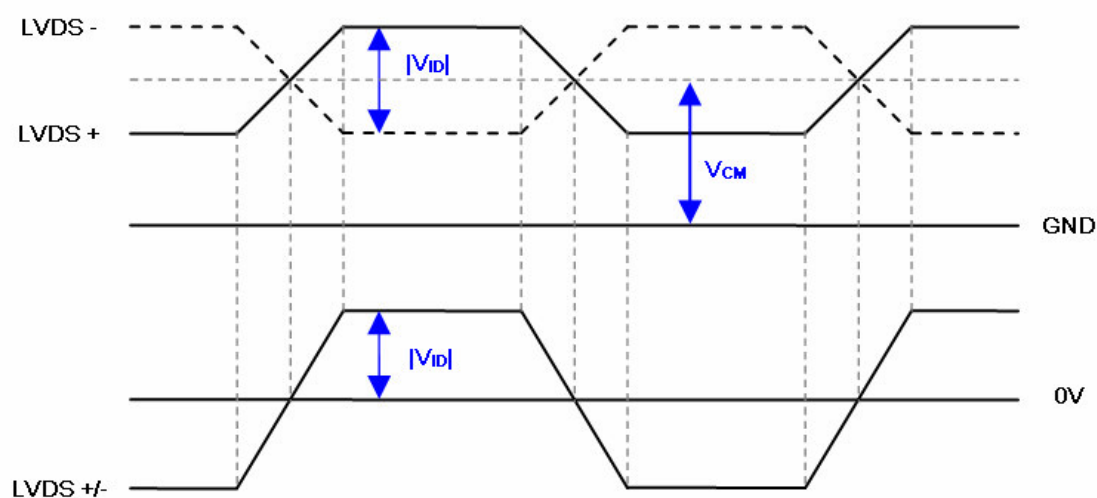
b. Black Pattern



Active Area

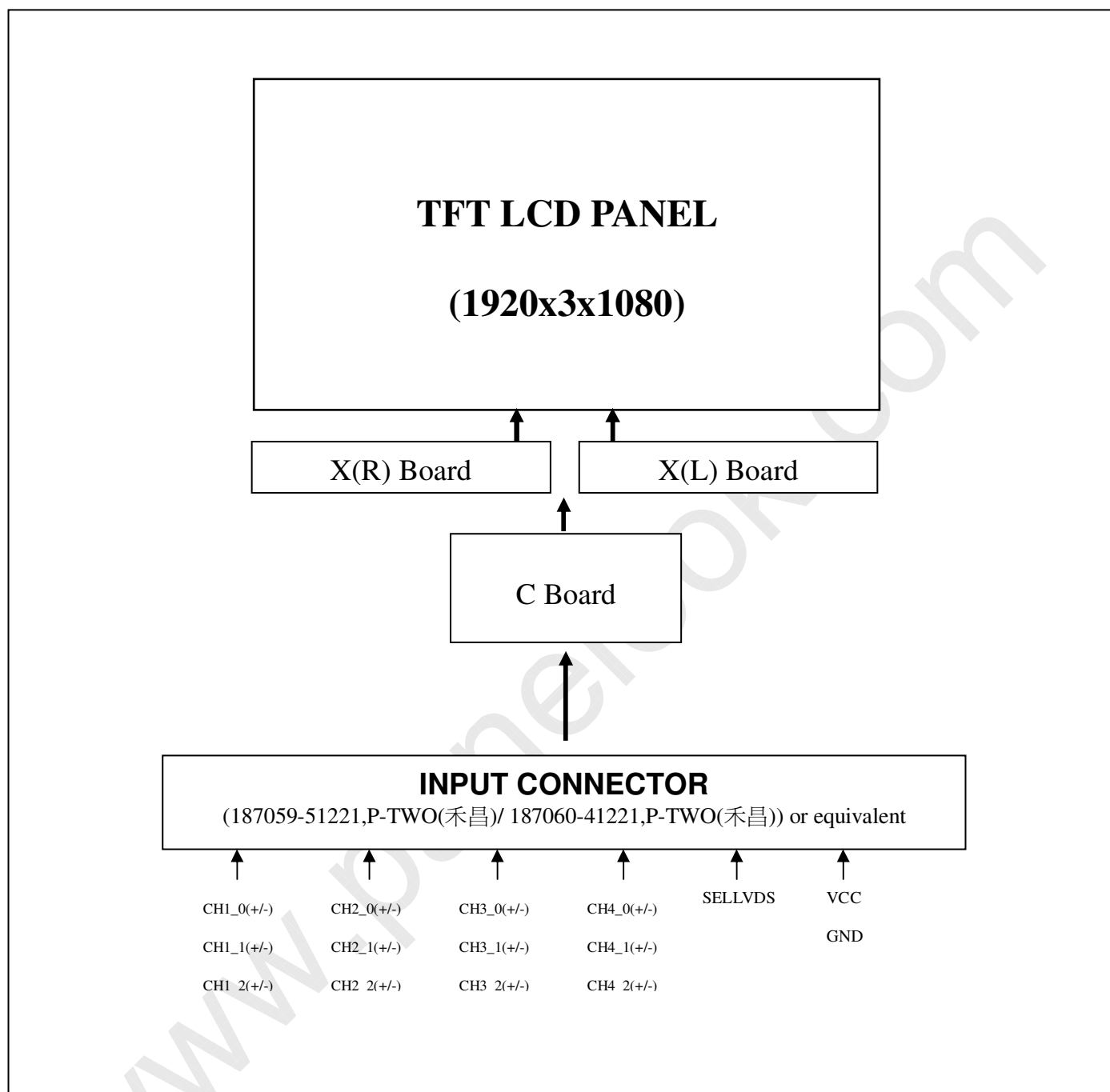


Note (4) The LVDS input characteristics are as follows:



## 4. BLOCK DIAGRAM OF INTERFACE

### 4.1 TFT LCD MODULE



## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 TFT LCD Module Input

CNF1 Connector Pin Assignment (187059-51221,P-TWO(禾昌) or equivalent)

| Pin | Name    | Description   | Note |
|-----|---------|---|------|
| 1   | GND     | Ground  |      |
| 2   | N.C.    | No Connection   | (1)  |
| 3   | N.C.    | No Connection   | (1)  |
| 4   | N.C.    | No Connection   | (1)  |
| 5   | N.C.    | No Connection   | (1)  |
| 6   | N.C.    | No Connection   | (1)  |
| 7   | SELLVDS | LVDS Data Format Selection                                  | (2)  |
| 8   | N.C.    | No Connection   | (1)  |
| 9   | N.C.    | No Connection   | (1)  |
| 10  | N.C.    | No Connection   | (1)  |
| 11  | GND     | Ground  |      |
| 12  | CH1[0]- | First pixel Negative LVDS differential data input. Pair 0   |      |
| 13  | CH1[0]+ | First pixel Positive LVDS differential data input. Pair 0   |      |
| 14  | CH1[1]- | First pixel Negative LVDS differential data input. Pair 1   |      |
| 15  | CH1[1]+ | First pixel Positive LVDS differential data input. Pair 1   |      |
| 16  | CH1[2]- | First pixel Negative LVDS differential data input. Pair 1 2 |      |
| 17  | CH1[2]+ | First pixel Positive LVDS differential data input. Pair 2   |      |
| 18  | GND     | Ground  |      |
| 19  | CH1CLK- | First pixel Negative LVDS differential clock input.         |      |
| 20  | CH1CLK+ | First pixel Positive LVDS differential clock input.         |      |
| 21  | GND     | Ground  |      |
| 22  | CH1[3]- | First pixel Negative LVDS differential data input. Pair 3   |      |
| 23  | CH1[3]+ | First pixel Positive LVDS differential data input. Pair 3   |      |
| 24  | CH1[4]- | First pixel Negative LVDS differential data input. Pair 4   |      |
| 25  | CH1[4]+ | First pixel Positive LVDS differential data input. Pair 4   |      |
| 26  | N.C.    | No Connection   | (1)  |
| 27  | N.C.    | No Connection   | (1)  |
| 28  | CH2[0]- | Second pixel Negative LVDS differential data input. Pair 0  |      |

|    |         |  |     |
|----|---------|--|-----|
| 29 | CH2[0]+ | Second pixel Positive LVDS differential data input. Pair 0 |     |
| 30 | CH2[1]- | Second pixel Negative LVDS differential data input. Pair 1 |     |
| 31 | CH2[1]+ | Second pixel Positive LVDS differential data input. Pair 1 |     |
| 32 | CH2[2]- | Second pixel Negative LVDS differential data input. Pair 2 |     |
| 33 | CH2[2]+ | Second pixel Positive LVDS differential data input. Pair 2 |     |
| 34 | GND     | Ground   |     |
| 35 | CH2CLK- | Second pixel Negative LVDS differential clock input.       |     |
| 36 | CH2CLK+ | Second pixel Positive LVDS differential clock input.       |     |
| 37 | GND     | Ground   |     |
| 38 | CH2[3]- | Second pixel Negative LVDS differential data input. Pair 3 |     |
| 39 | CH2[3]+ | Second pixel Positive LVDS differential data input. Pair 3 |     |
| 40 | CH2[4]- | Second pixel Negative LVDS differential data input. Pair 4 |     |
| 41 | CH2[4]+ | Second pixel Positive LVDS differential data input. Pair 4 |     |
| 42 | N.C.    | No Connection  | (1) |
| 43 | N.C.    | No Connection  | (1) |
| 44 | GND     | Ground   |     |
| 45 | GND     | Ground   |     |
| 46 | GND     | Ground   |     |
| 47 | N.C.    | No Connection  | (1) |
| 48 | VCC     | +12V power supply  |     |
| 49 | VCC     | +12V power supply  |     |
| 50 | VCC     | +12V power supply  |     |
| 51 | VCC     | +12V power supply  |     |

CNF2 Connector Pin Assignment (187060-41221,P-TWO(禾昌) or equivalent)

| Pin | Name | Description   | Note |
|-----|------|---------------|------|
| 1   | GND  | Ground        |      |
| 2   | N.C. | No Connection | (1)  |
| 3   | N.C. | No Connection | (1)  |
| 4   | N.C. | No Connection | (1)  |
| 5   | N.C. | No Connection | (1)  |



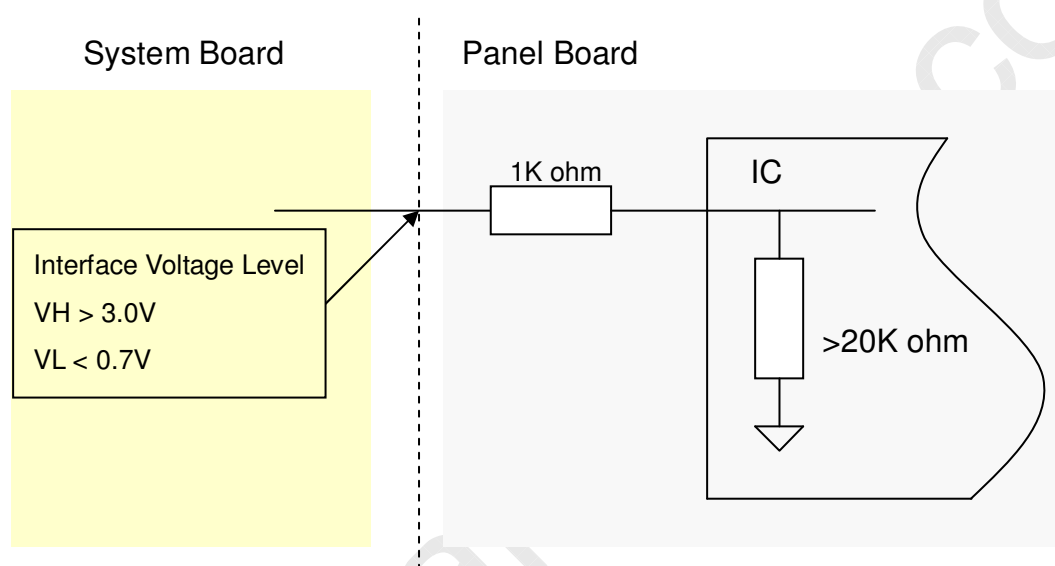
|    |         |  |     |
|----|---------|--|-----|
| 6  | N.C.    | No Connection  | (1) |
| 7  | N.C.    | No Connection  | (1) |
| 8  | N.C.    | No Connection  | (1) |
| 9  | GND     | Ground   |     |
| 10 | CH3[0]- | Third pixel Negative LVDS differential data input. Pair 0  |     |
| 11 | CH3[0]+ | Third pixel Positive LVDS differential data input. Pair 0  |     |
| 12 | CH3[1]- | Third pixel Negative LVDS differential data input. Pair 1  |     |
| 13 | CH3[1]+ | Third pixel Positive LVDS differential data input. Pair 1  |     |
| 14 | CH3[2]- | Third pixel Negative LVDS differential data input. Pair 2  |     |
| 15 | CH3[2]+ | Third pixel Positive LVDS differential data input. Pair 2  |     |
| 16 | GND     | Ground   |     |
| 17 | CH3CLK- | Third pixel Negative LVDS differential clock input.        |     |
| 18 | CH3CLK+ | Third pixel Positive LVDS differential clock input.        |     |
| 19 | GND     | Ground   |     |
| 20 | CH3[3]- | Third pixel Negative LVDS differential data input. Pair 3  |     |
| 21 | CH3[3]+ | Third pixel Positive LVDS differential data input. Pair 3  |     |
| 22 | CH3[4]- | Third pixel Negative LVDS differential data input. Pair 4  |     |
| 23 | CH3[4]+ | Third pixel Positive LVDS differential data input. Pair 4  |     |
| 24 | N.C.    | No Connection  | (1) |
| 25 | N.C.    | No Connection  | (1) |
| 26 | CH4[0]- | Fourth pixel Negative LVDS differential data input. Pair 0 |     |
| 27 | CH4[0]+ | Fourth pixel Positive LVDS differential data input. Pair 0 |     |
| 28 | CH4[1]- | Fourth pixel Negative LVDS differential data input. Pair 1 |     |
| 29 | CH4[1]+ | Fourth pixel Positive LVDS differential data input. Pair 1 |     |
| 30 | CH4[2]- | Fourth pixel Negative LVDS differential data input. Pair 2 |     |
| 31 | CH4[2]+ | Fourth pixel Positive LVDS differential data input. Pair 2 |     |
| 32 | GND     | Ground   |     |
| 33 | CH4CLK- | Fourth pixel Negative LVDS differential clock input.       |     |
| 34 | CH4CLK+ | Fourth pixel Positive LVDS differential clock input.       |     |
| 35 | GND     | Ground   |     |
| 36 | CH4[3]- | Fourth pixel Negative LVDS differential data input. Pair 3 |     |
| 37 | CH4[3]+ | Fourth pixel Positive LVDS differential data input. Pair 3 |     |

|    |         |  |     |
|----|---------|--|-----|
| 38 | CH4[4]- | Fourth pixel Negative LVDS differential data input. Pair 4 |     |
| 39 | CH4[4]+ | Fourth pixel Positive LVDS differential data input. Pair 4 |     |
| 40 | N.C.    | No Connection  | (1) |
| 41 | N.C.    | No Connection  | (1) |

Note (1) Reserved for internal use. Please leave it open.

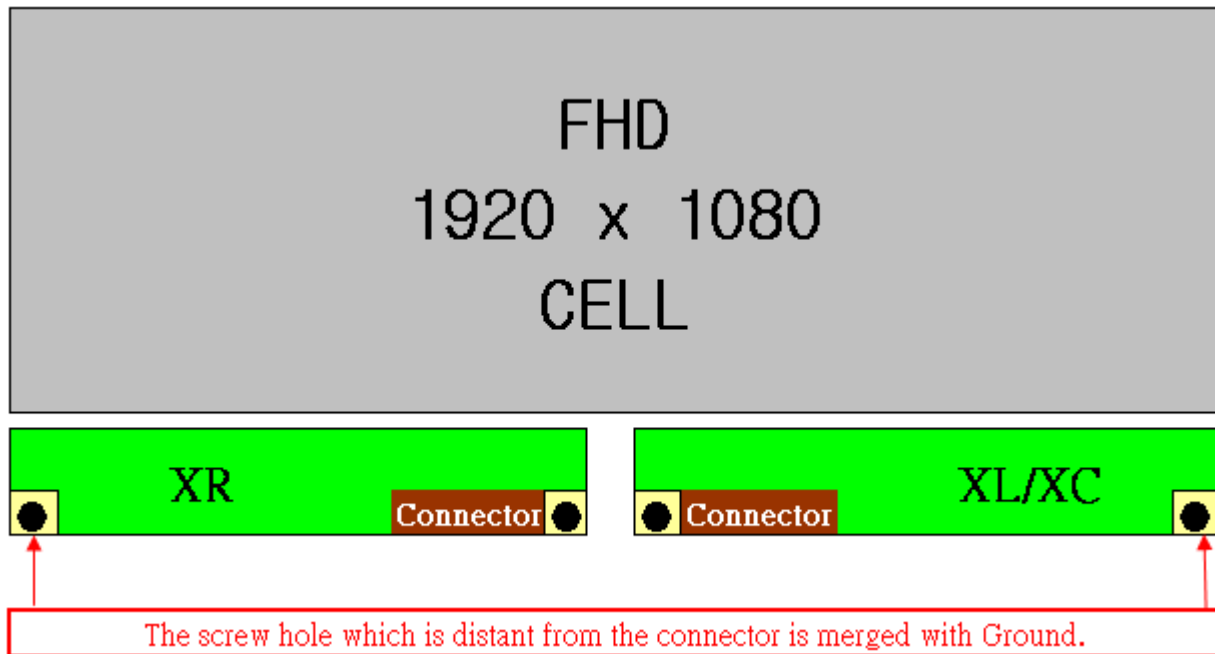
Note (2) High=connect to +3.3V: JEIDA Format ; Low= connect to GND or Open: VESA Format.

Note (3) Interface optional pin has internal scheme as following diagram. Customer should keep the interface voltage level requirement as below.



Note (4) LVDS 4-port Data Mapping

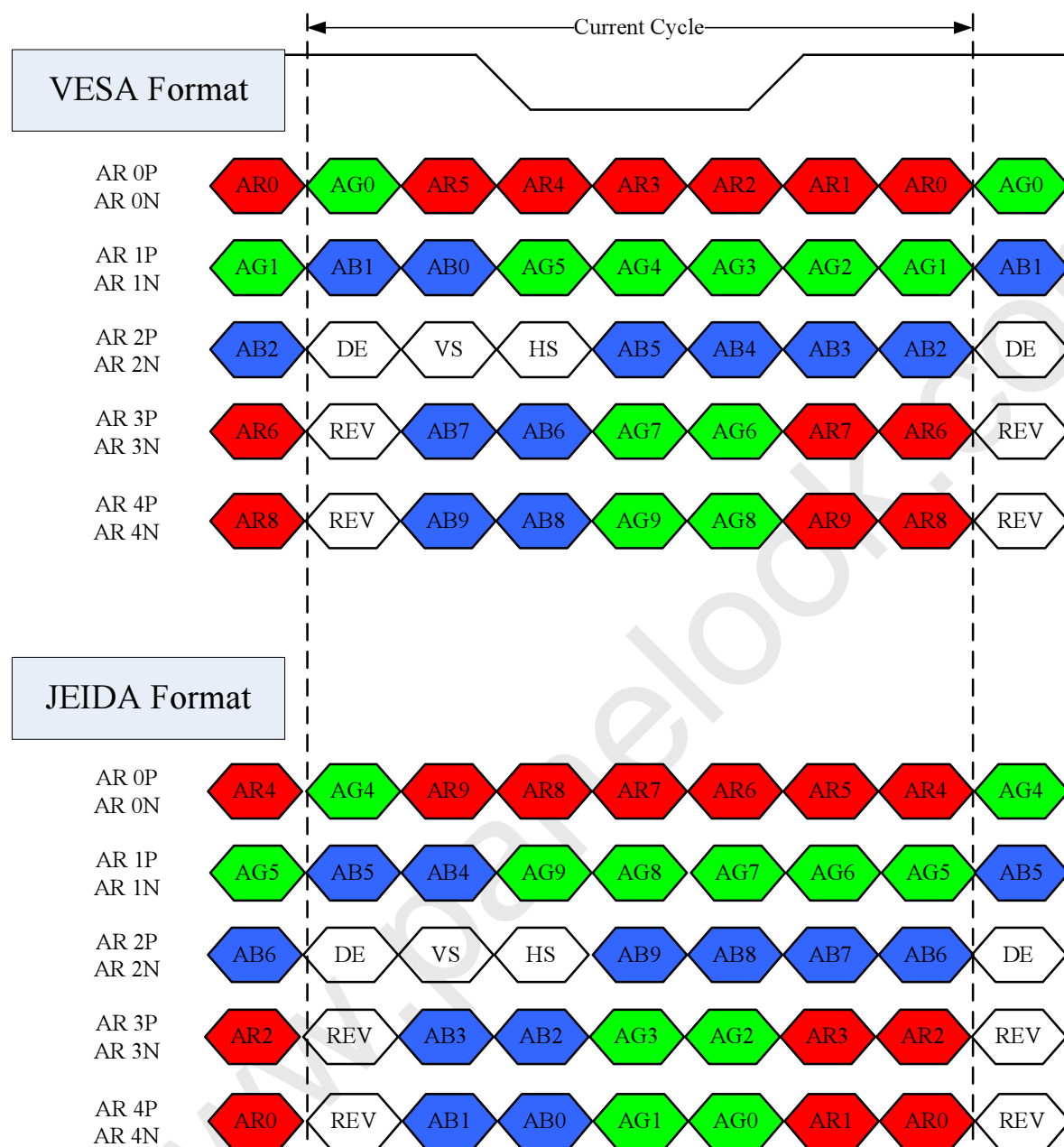
| Port     | Channel of LVDS | Data Stream              |
|----------|-----------------|--------------------------|
| 1st Port | First Pixel     | 1, 5, 9, .....1913, 1917 |
| 2nd Port | Second Pixel    | 2, 6, 10, ....1914, 1918 |
| 3rd Port | Third Pixel     | 3, 7, 11, ....1915, 1919 |
| 4th Port | Fourth Pixel    | 4, 8, 12, ....1916, 1920 |



## 5.2 LVDS INTERFACE

VESA Format : SELLVDS = L or Open

JEIDA Format : SELLVDS = H



AR0~AR9: First Pixel R Data (9; MSB, 0; LSB)

AG0~AG9: First Pixel G Data (9; MSB, 0; LSB)

AB0~AB9: First Pixel B Data (9; MSB, 0; LSB)

DE : Data enable signal

DCLK : Data clock signal

RSV : Reserved

## 5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 10-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of the color versus data input.

| Color               |                  | Data Signal |    |    |    |    |    |    |    |    |    |       |    |    |    |    |    |    |    |    |    |      |    |    |    |    |    |    |    |   |  |  |  |
|---------------------|------------------|-------------|----|----|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|---|--|--|--|
|                     |                  | Red         |    |    |    |    |    |    |    |    |    | Green |    |    |    |    |    |    |    |    |    | Blue |    |    |    |    |    |    |    |   |  |  |  |
|                     |                  |             |    |    |    |    |    |    |    |    |    |       |    |    |    |    |    |    |    |    |    |      |    |    |    |    |    |    |    |   |  |  |  |
| R9                  | R8               | R7          | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G9 | G8 | G7    | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B9 | B8 | B7   | B6 | B5 | B4 | B3 | B2 | B1 | B0 |   |  |  |  |
| Basic Colors        | Black            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0 |  |  |  |
|                     | Red              | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Green            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Blue             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |  |  |  |
|                     | Cyan             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |  |  |  |
|                     | Magenta          | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |  |  |  |
|                     | Yellow           | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | White            | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |  |  |  |
| Gray Scale Of Red   | Red (0) / Dark   | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Red (1)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Red (2)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | :                |             |    | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |   |  |  |  |
|                     | :                |             |    | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |   |  |  |  |
|                     | Red (1021)       | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Red (1022)       | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Red (1023)       | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
| Gray Scale Of Green | Green (0) / Dark | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Green (1)        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Green (2)        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | :                | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |   |  |  |  |
|                     | :                | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |   |  |  |  |
|                     | Green (1021)     | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Green (1022)     | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Green (1023)     | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
| Gray Scale Of Blue  | Blue (0) / Dark  | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |  |  |  |
|                     | Blue (1)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 1  |   |  |  |  |
|                     | Blue (2)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 1  | 0  |   |  |  |  |
|                     | :                | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |   |  |  |  |
|                     | :                | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |   |  |  |  |
|                     | Blue (1021)      | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 0  | 1  |   |  |  |  |

|             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue (1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Blue (1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

## 5.4 FLICKER (V-com) ADJUSTMENT

### (1) Adjustment Pattern:

Column-inversion pattern was shown as below. If customer need below pattern, please directly contact with Account FAE.

Frame N

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| + | - | + | - | + | - |
| + | - | + | - | + | - |
| + | - | + | - | + | - |
| + | - | + | - | + | - |
| + | - | + | - | + | - |
| + | - | + | - | + | - |
| + | - | + | - | + | - |
| + | - | + | - | + | - |

Frame N+1

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| - | + | - | + | - | + |
| - | + | - | + | - | + |
| - | + | - | + | - | + |
| - | + | - | + | - | + |
| - | + | - | + | - | + |
| - | + | - | + | - | + |
| - | + | - | + | - | + |
| - | + | - | + | - | + |

### (2) Adjustment method: (Digital V-com)

Programmable memory IC is used for Digital V-com adjustment in this model. CMI provide Auto V-com tools to adjust Digital V-com. The detail connection and setting instruction, please directly contact with Account FAE or refer CMI Auto V-com adjustment OI. Below items is suggested to be ready before Digital V-com adjustment in customer LCM line.



## 6. INTERFACE TIMING

### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

(Ta = 25 ± 2 °C)

The input signal timing specifications are shown as the following table and timing diagram.

| Signal                         | Item                                 | Symbol                    | Min.               | Typ.  | Max.               | Unit | Note                |
|--------------------------------|--------------------------------------|---------------------------|--------------------|-------|--------------------|------|---------------------|
| LVDS Receiver Clock            | Frequency                            | $F_{clk_{in}}$<br>(=1/TC) | 60                 | 74.25 | 80                 | MHz  |                     |
|                                | Input cycle to cycle jitter          | $T_{rcl}$                 | —                  | —     | 200                | ps   | (3)                 |
|                                | Spread spectrum modulation range     | $F_{clk_{in\_mod}}$       | $F_{clk_{in}}-2\%$ | —     | $F_{clk_{in}}+2\%$ | MHz  | (4)                 |
|                                | Spread spectrum modulation frequency | $F_{SSM}$                 |                    |       | 200                | KHz  |                     |
| LVDS Receiver Data             | Setup Time                           | $T_{lvsu}$                | 600                | —     | —                  | ps   | (5)                 |
|                                | Hold Time                            | $T_{lvhd}$                | 600                | —     | —                  | ps   |                     |
| Vertical Active Display Term   | Frame Rate                           | $F_{r5}$                  | —                  | 100   | —                  | Hz   |                     |
|                                |                                      | $F_{r6}$                  | —                  | 120   | —                  | Hz   |                     |
|                                | Total                                | $T_v$                     | 1115               | 1125  | 1135               | Th   | $T_v=T_{vd}+T_{vb}$ |
|                                | Display                              | $T_{vd}$                  | 1080               | 1080  | 1080               | Th   | —                   |
|                                | Blank                                | $T_{vb}$                  | 35                 | 45    | 55                 | Th   | —                   |
| Horizontal Active Display Term | Total                                | $T_h$                     | 540                | 550   | 575                | Tc   | $T_h=T_{hd}+T_{hb}$ |
|                                | Display                              | $T_{hd}$                  | 480                | 480   | 480                | Tc   | —                   |
|                                | Blank                                | $T_{hb}$                  | 60                 | 70    | 95                 | Tc   | —                   |

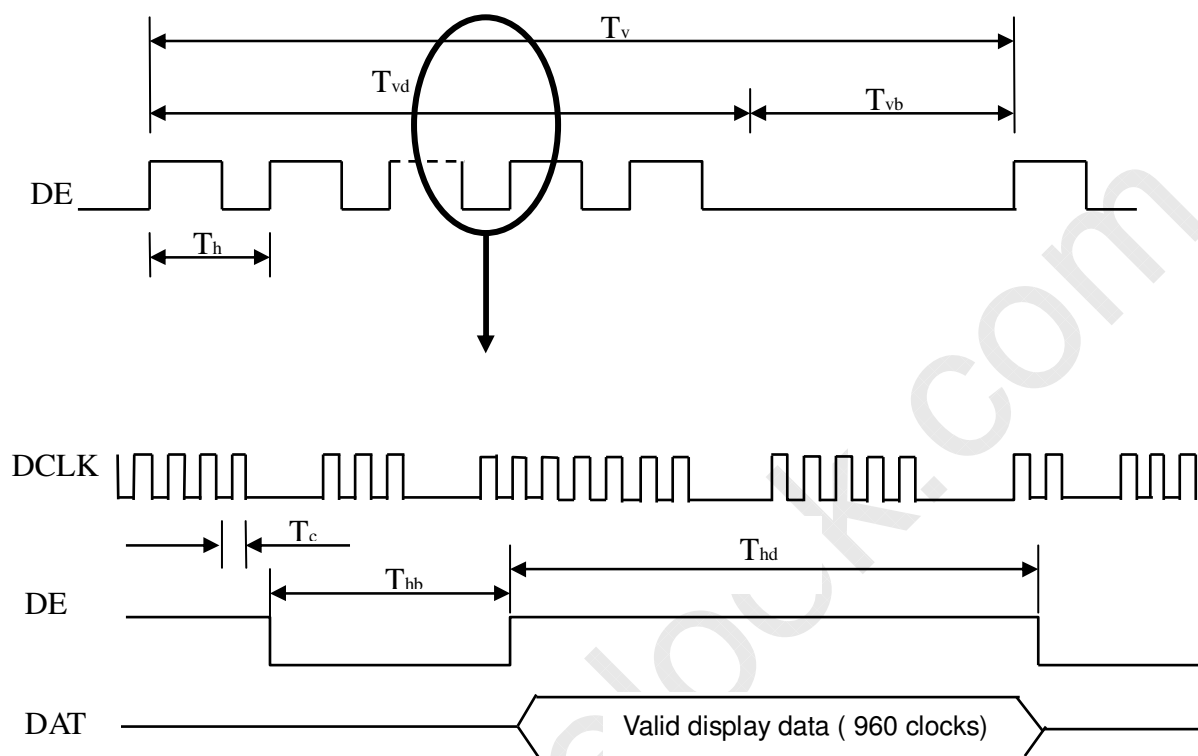
Note (1) Since the module is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this module would operate abnormally.

Note (2) Please make sure the range of pixel clock has follow the below equation:

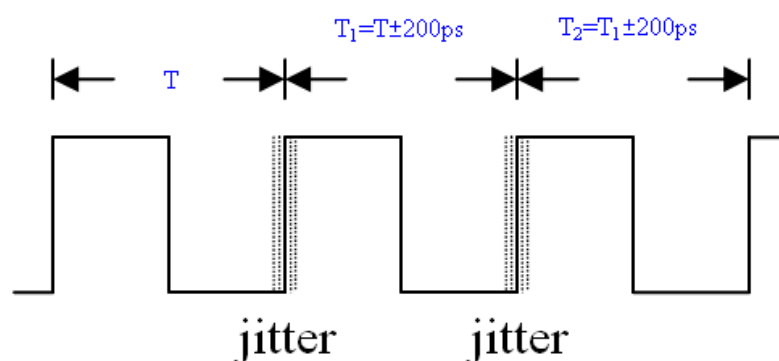
$$F_{clk_{in}}(\max) \geq F_{r6} \times T_v \times T_h$$

$$F_{r5} \times T_v \times T_h \geq F_{clk_{in}}(\min)$$

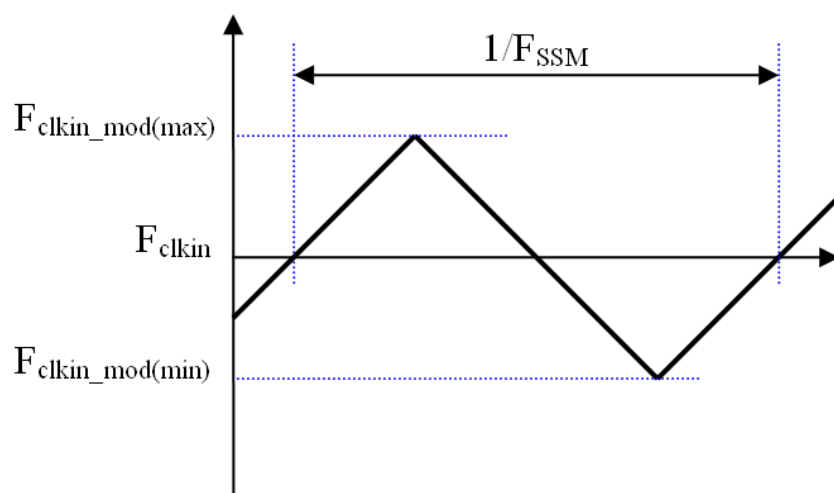
## INPUT SIGNAL TIMING DIAGRAM



Note (3) The input clock cycle-to-cycle jitter is defined as below figures.  $Trcl = |T_1 - T_1|$

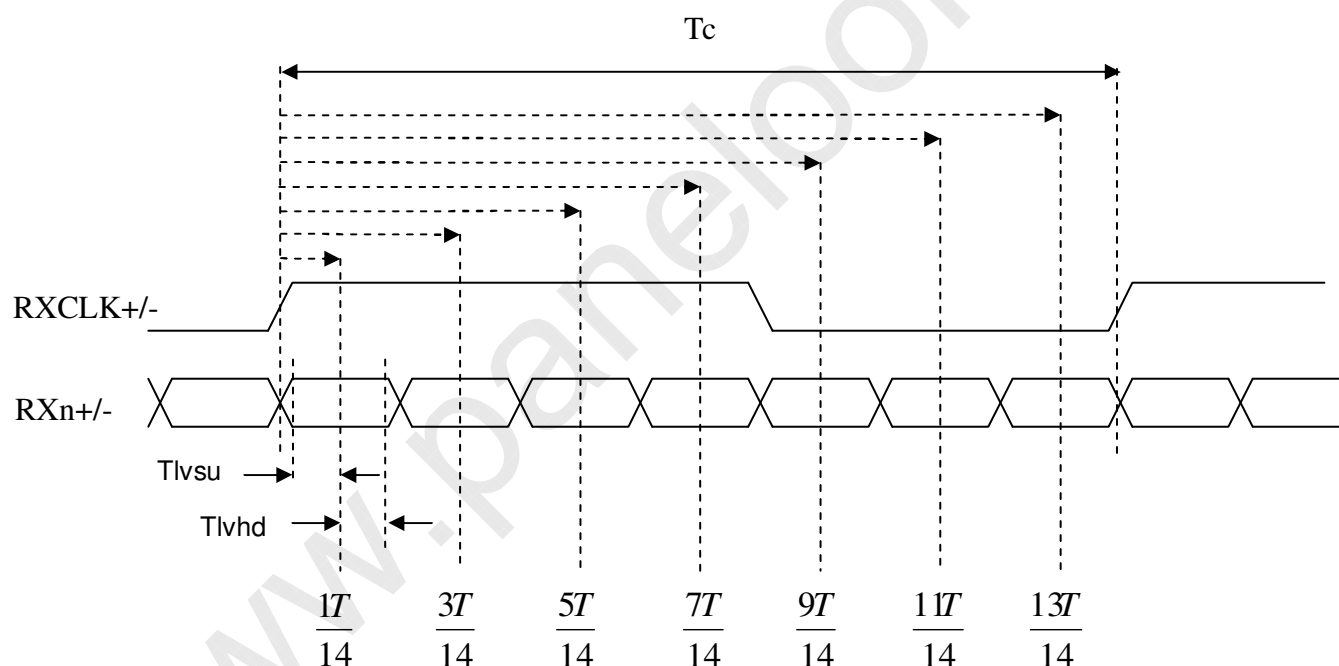


Note (4) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (5) The LVDS timing diagram and setup/hold time is defined and showing as the following figures.

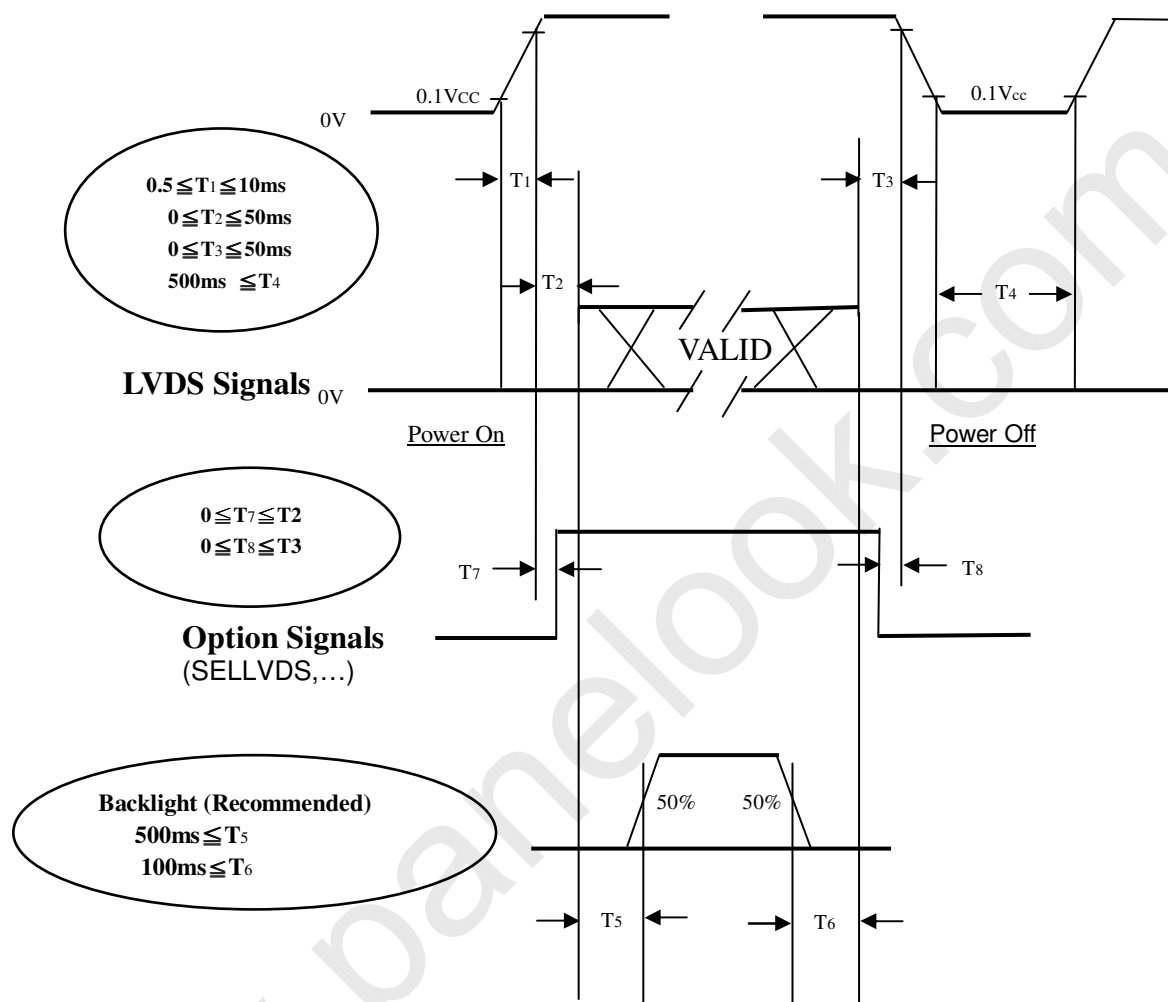
## LVDS RECEIVER INTERFACE TIMING DIAGRAM



## 6.2 POWER ON/OFF SEQUENCE

( $T_a = 25 \pm 2^\circ\text{C}$ )

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.



**Power ON/OFF Sequence**

Note (1) The supply voltage of the external system for the module input should follow the definition of Vcc.

Note (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of Vcc is in off level, please keep the level of input signals on the low or high impedance. If  $T_2 < 0$ , that maybe cause electrical overstress failure.

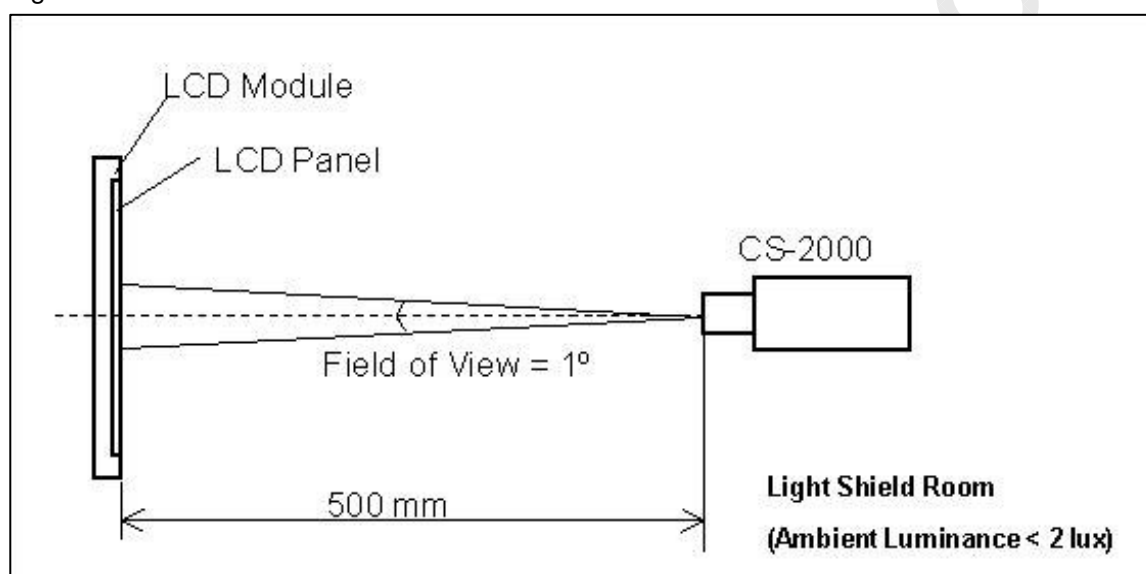
Note (4) T4 should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

**7. OPTICAL CHARACTERISTICS****7.1 TEST CONDITIONS**

| Item                | Symbol  | Value | Unit |
|---------------------|---|-------|------|
| Ambient Temperature | Ta  | 25±2  | °C   |
| Ambient Humidity    | Ha  | 50±10 | %RH  |
| Supply Voltage      | V <sub>CC</sub>   | 12.0  | V    |
| Input Signal        | According to typical value in "3. ELECTRICAL CHARACTERISTICS" |       |      |
| LED Current         | I <sub>L</sub>  | 120   | mA   |
| Vertical Frame Rate | Fr  | 120   | Hz   |

The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring in a windless room.



## 7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown as below. The following items should be measured under the test conditions described in 7.1 and stable environment shown in 7.1.

| Item                 |            | Symbol        | Condition  | Min. | Typ.  | Max. | Unit | Note    |
|----------------------|------------|---------------|--|------|-------|------|------|---------|
| Color Chromaticity   | Red        | Rcx           | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>Viewing Angle at Normal Direction<br>Standard light source “C” | -    | 0.650 | -    | -    | (0),(5) |
|                      |            | Rcy           |  |      | 0.325 |      | -    |         |
|                      | Green      | Gcx           |  |      | 0.265 |      | -    |         |
|                      |            | Gcy           |  |      | 0.570 |      | -    |         |
|                      | Blue       | Bcx           |  |      | 0.131 |      | -    |         |
|                      |            | Bcy           |  |      | 0.122 |      | -    |         |
|                      | White      | Wcx           |  |      | 0.297 |      | -    |         |
|                      |            | Wcy           |  |      | 0.344 |      | -    |         |
| Center Transmittance |            | T%            | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>with CMI module  | -    | 4.8   | -    | %    | (1),(7) |
| Contrast Ratio       |            | CR            |  |      | 6500  | -    | -    | (1),(3) |
| Response Time        |            | Gray to gray  | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>with CMI Module@60Hz   | -    | 5.5   |      |      | (1),(4) |
| White Variation      |            | $\delta W$    | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>with CMI module  | -    | -     | 1.3  | -    | (1),(6) |
| Viewing Angle        | Horizontal | $\theta_{x+}$ | $CR\geq 20$<br>with CMI module   |      | 88    |      | Deg. | (1),(2) |
|                      |            | $\theta_{x-}$ |  |      | 88    |      |      |         |
|                      | Vertical   | $\theta_{Y+}$ |  |      | 88    |      |      |         |
|                      |            | $\theta_{Y-}$ |  |      | 88    |      |      |         |

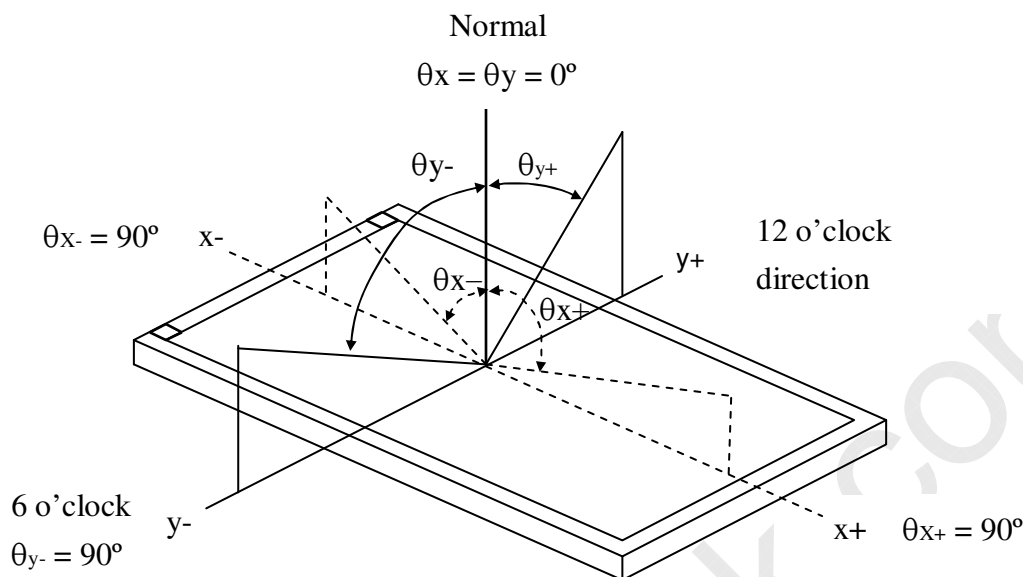
Note (0) Light source is the standard light source "C" which is defined by CIE and driving voltage are based on suitable gamma voltages. The calculating method is as following:

1. Measure Module's W,R,G,B spectrum and BLU's spectrum. Which BLU (for V460H1-LE3) is supplied by CMI.
2. Calculate cell's spectrum.
3. Calculate cell's chromaticity by using the spectrum of standard light source "C".

Note (1) Light source is the BLU which supplied by CMI and driving voltage are based on suitable gamma voltages.

Note (2) Definition of Viewing Angle ( $\theta_x$ ,  $\theta_y$ ):

Viewing angles are measured by Autronic Conoscope Cono-80 ( or Eldim EZ-Contrast 160R )



Note (3) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

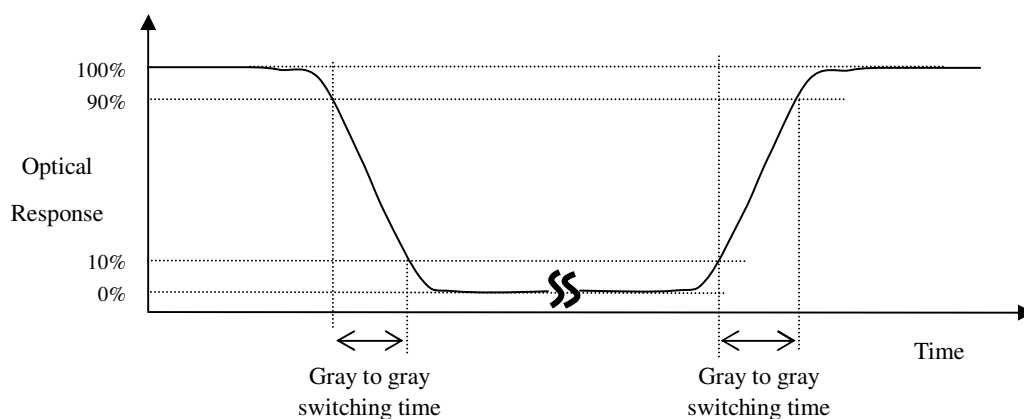
$$\text{Contrast Ratio (CR)} = \frac{\text{Surface Luminance of L1023}}{\text{Surface Luminance of L0}}$$

L255: Luminance of gray level 1023

L 0: Luminance of gray level 0

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (6).

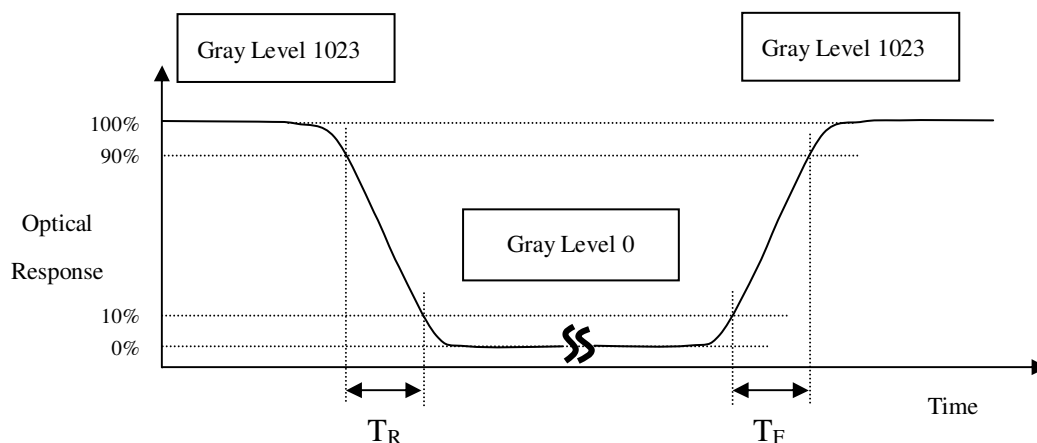
Note (4) Definition of Gray-to-Gray Switching Time:



The driving signal means the signal of gray level 0, 124, 252, 380, 508, 636, 764, 892 and 1023.

Gray to gray average time means the average switching time of gray level 0, 124, 252, 380, 508, 636, 764, 892 and 1023 to each other.

Note (5) Definition of Response Time ( $T_R$ ,  $T_F$ ):

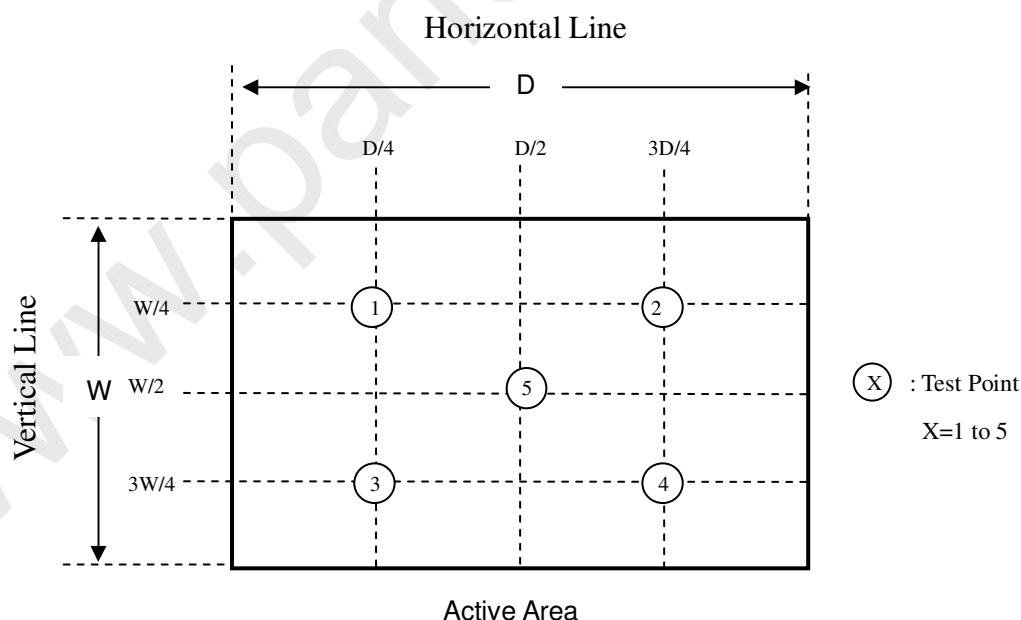


Note (6) Definition of White Variation ( $\delta W$ ):

Measure the luminance of gray level 1023 at 5 points

$$\delta W = \text{Maximum} [L(1), L(2), L(3), L(4), L(5)] / \text{Minimum} [L(1), L(2), L(3), L(4), L(5)]$$

where  $L(X)$  is corresponding to the luminance of the point  $X$  at the figure below.





Note (7) Definition of Transmittance (T%) :

Measure the luminance of gray level 1023 at center point of LCD module.

$$\text{Transmittance (T\%)} = \frac{\text{Luminance of LCD module}}{\text{Luminance of backligh unit}} \times 100\% \text{ PRECAUTIONS}$$

**8. PRECAUTIONS****8.1 ASSEMBLY AND HANDLING PRECAUTIONS**

- [ 1 ] Do not apply rough force such as bending or twisting to the module during assembly.
- [ 2 ] It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- [ 3 ] Do not apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.
- [ 4 ] Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- [ 5 ] The distance between COF edge and rib of BLU must bigger than 5mm. This can prevent the damage of COF when assemble the module.
- [ 6 ] Do not design sharp-pointed structure / parting line / tooling gate on the COF position of plastic parts, because the burr will scrape the COF.
- [ 7 ] If COF would bended to assemble in the module. Do not put the IC location on the bending corner of COF.
- [ 8 ] The gap between COF IC and any structure of BLU must bigger than 2mm. This can prevent the damage of COF IC
- [ 9 ] Bezel opening must have no burr. Burr will scrape the panel surface.
- [ 10 ] Bezel of module and bezel of set can not press or touch the panel surface. It will make light leakage or scrape.
- [ 11 ] When module used FFC / FPC, but no FFC / FPC to be attached in the open cell. Customer can refer the FFC / FPC drawing and buy it by self.
- [ 12 ] The gap between Panel and any structure of Bezel must bigger than 2mm. This can prevent the damage of Panel.
- [ 13 ] Do not plug in or pull out the I/F connector while the module is in operation.
- [ 14 ] Do not disassemble the module.
- [ 15 ] Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- [ 16 ] Moisture can easily penetrate into LCD module and may cause the damage during operation.
- [ 17 ] When storing modules as spares for a long time, the following precaution is necessary.
  - [ 17.1 ] Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C at normal humidity without condensation.
  - [ 17.2 ] The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.
- [ 18 ] When ambient temperature is lower than 10°C, the display quality might be reduced.

**8.2 SAFETY PRECAUTIONS**

- [ 1 ] The startup voltage of a Backlight is approximately 1000 Volts. It may cause an electrical shock while assembling with the inverter. Do not disassemble the module or insert anything into the Backlight unit.
- [ 2 ] If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of



contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

[ 3 ] After the module's end of life, it is not harmful in case of normal operation and storage.

## 9. DEFINITION OF LABELS

### 9.1 CMI OPEN CELL LABEL

The barcode nameplate is pasted on each open cell as illustration for CMI internal control.



### 9.2 CARTON LABEL

The barcode nameplate is pasted on each box as illustration, and its definitions are as following explanation



(a) Model Name: V460HK1– PS1

(b) Carton ID: CMI internal control

(c) Quantities: 8

## 10. PACKAGING

### 10.1 PACKAGING SPECIFICATIONS

- (1) 8 LCD TV PANELS / 1 BOX
- (2) BOX DIMENSIONS :1238 (L) X 842 (W) X 240(H)
- (3) WEIGHT : APPROXIMATELY 38KG (8 PANELS PER BOX)

### 10.2 PACKAGING METHOD

Figures 10-1 and 10-2 are the packing method

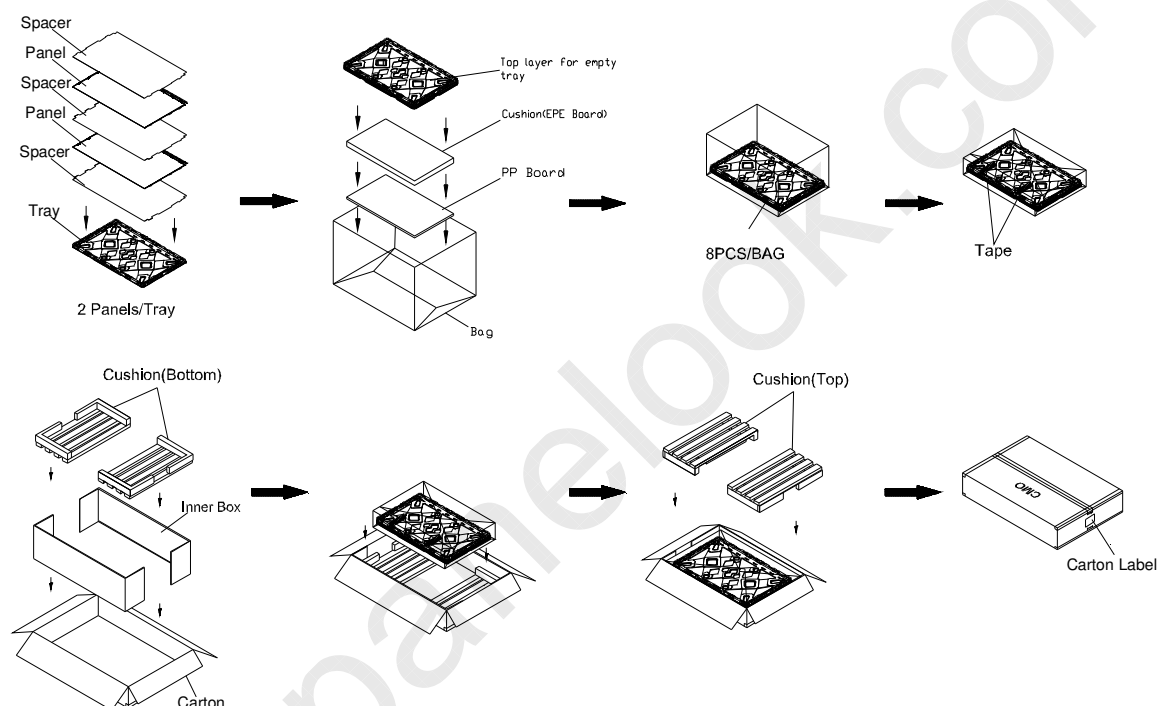
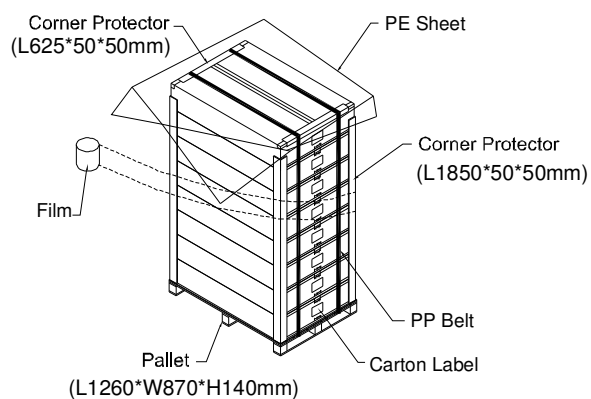


Figure.10-1 packing method



## Sea &amp; Land Transportation



## Air Transportation

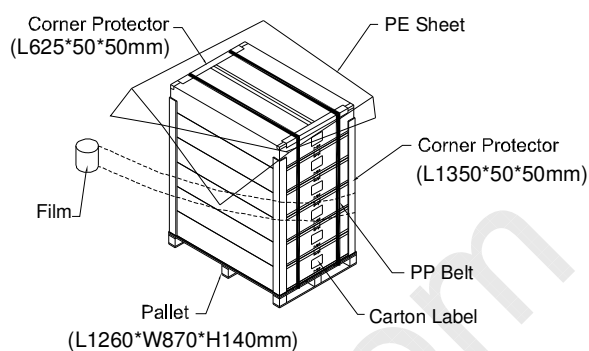


Figure.10-2 packing method

## 11. MECHANICAL CHARACTERISTIC

